CIMdata Review
Of US Army's ACMS Vision

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Prepared by:
CIMdata, Inc.

Alan F. Mendel
Peter A. Bilello

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Introduction

BDM International, Inc. has requested CIMdata under contract to briefly review the US Army's Draft Concept of Operations (CONOPS) for an Automated Configuration Management System (ACMS) against the commercial PDM market. This review is focused on the ability for the commercial PDM market to satisfy the CONOPS for ACMS.

This is a brief review with CIMdata providing comments upon review of the following information provided by BDM International:

- an electronic copy of the 1997 ACMS Draft CONOPS (dated 12/4/97)

- an electronic copy of a meeting book from the November 1997 ACMS Task Force Status meeting notes (Meeting book to include results from the detailed Army review of the ACMS problem statement, vision, and CONOPS – less than 30 pages)

To assist in the process of communicating our comments on the ACMS CONOPS, CIMdata has organized this document using the CIMdata PDM functional model. We have additional provided a few recommendations for consideration by the ACMS Task Force to facilitate the commercial PDM and related technology markets to offer Commercial off the Shelf (COTS) solutions to the US Army. These recommendations are included in the comments.

The comments in this document are also applicable to the early draft copy of the ACMS requirement spreadsheet sent to CIMdata.

Review Comments

General Observations

General observations on the ACMS CONOPS vision document are:

- The vision is detailed in its desire for a common solution (ACMS) to access and manage product information and processes.

- The vision states that even though a common solution is desired, that flexibility is to be maintained to support Command specific requirements and implementations.

- The vision calls for ACMS to support traditional configuration management functions, management of product structures, management of product data, engineering change proposal processing and the Army's Tech Loop functions (purchasing/procurement activities).

- The vision requires that ACMS will interface, link, and synchronize with legacy systems such as JCALS Workflow Manager, JEDMICS, CITIS and local PDM systems.

- The vision includes accessing information from suppliers to the US Army, but does not require them to use the same ACMS as the Army.

- The vision acknowledges that suppliers have similar types of systems (containing parts of the functionality desired for ACMS) in place (e.g., CITIS, PDM, Document Managers, etc.) and that these will need to be interfaced to ACMS for the vision to truly function.

- The vision supports different methodologies for managing information where the US Army has Current Data Change Authority (CDCA) and where it has not.

- The vision defines the ACMS solution to support a set of core Army product data, while at the same time allowing local commands to define extensions and additional applications for their local implementations.

- The vision defines a role for ACMS to support selected business processes: Integrated Product Teams (IPT), Engineering Change Action Processing, and Technical Data Package (TDP) Validation.

Purpose

The ACMS CONOPS vision for a US Army common system to manage product data, configuration management and sharing across its distributed commands and through its supply chain of subcontractors is similar to large multinational enterprises. The purpose defined in this draft CONOPS is consistent with the general market and direction of large industrial enterprises.

Large enterprises, especially those that are multinational, are struggling with the management and access of increasingly large amounts of product data and establishing an integrated product development environment that leverages their distributed resources. Over the last few years this vision has been expanded into the supply chain.

Commercial vendors are selling this long-term vision and have been building technologies to better deliver solutions towards realization of this vision. Currently, large enterprises have implemented pieces of this vision.

Scope

The defined scope for ACMS to be the Army's enterprise product data management system is again consistent with large industrial enterprises. Further, ACMS is defined to *enable management of the Army's product data throughout the life-cycle of a system – from program development through production, sustainment, modification, and ultimately disposal*. This is also consistent with the long-term direction of large enterprises.

The concern we have with this scope is that large enterprises envision this scope as their long-term direction, not immediate requirements. The commercial market is moving in this direction, but have not successfully delivered a solution for a "Federated System of Systems" to date.

In addition, the requirement for integration and in certain cases the synchronization with legacy systems can only be deliver by COTS based on open fully accessible APIs and custom implementation efforts. Custom interfaces are costly to develop and require adequate APIs to be available from the legacy systems to be interfaced. The requirement to interface to these legacy systems is understandable. The Army must realize that these interfaces are not one time cost items, but must be maintained as the COTS systems are upgraded and as local Commands further customize their implementations of ACMS. The costs maybe reduced by leveraging Web based technologies rather than to rely solely on point to point integrations.

The scope of managing engineering change across the supply chain is also a requirement that to our knowledge has only been successfully implemented on a very limited basis.

Enterprises have been successful in implementations of data vaults and limited change management systems that span geographical facilities and extend into the supply chain. Most of these have been customized systems, rather than COTS solutions. We are not suggesting that this scope is too broad or that the high-end COTS solutions can not address it over time. Our concern is centered on the lack of specific mention of phases for the scope to be implemented to allow both the commercial vendors and the organizations to deliver.

The enterprises that have been successful in implemented large scope solutions have implemented a combination of horizontal limited functional capabilities and vertical more fully functional capabilities. Horizontal PDM implementation refers to the deployment of a set of capabilities, such as Data Vaulting, across multiple divisions or organizations at the same time. This strategy works because the scope of functionality to be implemented is kept small and is visible and used by many users. Vertical PDM implementation refers to the deployment of a robust set of capabilities, such as Data Vaulting, Workflow and configuration management, across a smaller group or department. This strategy works because the number of users that are affected is kept small and they can focus on driving a lot more functionality.

A recommendation for the US Army is to implement both strategies. For example, Data Vaulting for released engineering product data can be developed and implemented throughout the commands and accessible by the supply chain. At the same time certain engineering development project teams can be implemented with configuration management, workflow and data vaulting for their current programs.

ACMS Vision and Goals

Our comments to the ACMS CONOPS vision and goals sections will focus on the concerns we have for commercial systems to deliver solutions based on the described functionality.

The number one concern, as mentioned previously, is that commercial systems have been successful in federated vaulting. They have not been largely successful in establishing a configuration management system that manages all engineering product data through its life cycle and across different implementations of the system that are interfaced to multiple

legacy and supply chain systems. The ability for such a vision to become a reality will, at the very, least require a multi-phased implementation approach of functionality and definition of standard core product data that are adhered to by all commands and supply chain subcontractors.

Allowing local commands to further extend their local implementations of ACMS is, in theory, feasible but clear guidelines will be required. The extent of this local customization will be limited to the ability for the COTS selected to support the upgrade and maintenance of such implementations under the federated goal. The trend in the industry is to prefer tailoring for multiple implementations rather than customization to the data model and application. If the customization of the different command ACMS are not managed with clear guidelines (e.g., only additional sub-classing will be allowed) additional points of failures will be created.

All PDM COTS solutions can restrict access to information; however, the ability to actually see certain data is not always supported depending on the extent visualization is defined.

The concept of different ACMS solutions being implemented at different sites will further complicate the realization of a federated solution. Certainly it is expected that there will be different COTS component technologies and applications implemented (Web, view and markup, backup, imaging tools, etc.), however, for the Army to get the best opportunity to realize the full scope of this CONOPS the major ACMS installations should be based on the same COTS solution.

The MIL-STD-2549 is clearly defined as the data exchange definition for core ACMS data. This standard is specifically mentioned as a requirement that is to be phased in over time. This standard is defined as potentially the principle mechanism for the exchange of core product data between ACMS sites and between subcontractors. All these expectations are critical components in the full realization of the ACMS CONOPS vision. The concern is that this standard, to our knowledge has not been implemented within any of the COTS.

It is defined for ACMS to provide access to product structures where the Army is not the CDCA. There is no real definition of how this is to be delivered. We suggest that Intranet/Extranet/Web technologies be investigated to provide the infrastructure for COTS to leverage. This is the current trend in the PDM market for the fulfillment of this requirement. This idea works with new systems that can support the Web technology, older systems will require custom interfaces and/or the use of component technologies.

The requirement for the existing infrastructure to be used is reasonable if the infrastructure is close to the general market. If the infrastructure is not, then the commercial vendor will need to support platforms that are custom or older requiring additional development and testing effort. The long-term effect of this situation usually leads to a counter productive environment for commercial vendors and the customers not able to leverage the COTS ongoing development.

ACMS Concept

Within the concept section there is a requirement for Enterprise-level Visibility of data. This is definitely a major trend in the PDM market: the enterprise solution is not a single solution but supports the environment of multiple PDM systems and local data managers. This is further discussed to include the concept that local PDM and data managers will store and manage application data and then provide a subset of that data to the enterprise PDM system. The granularity of the subset of information is sufficient to manage and share through the enterprise.

Our concern is that if users are to have access to data that is stored in the supply chain system (Subcontractor is the CDCA), how did the enterprise system (ACMS) get knowledge of it? Many industries use the enterprise PDM to be the approval and release system. When data is in-process or under development, the enterprise PDM system does not have access to it outside of knowing that perhaps an order (Engineering Change Order) is active for its creation (i.e., a new revision is being created). Other organizations have envisioned this access to be the ability for the user to access the subcontractor's system rather than go through the enterprise system (e.g., Web access).

The concept for the US Army to move to a product centric approach to data management is both consistent with the PDM market and applauded by CIMdata. However, this will take time to be fully implemented across the different commands and through the supply chain. PDM systems have been successful in supporting this change. The ability for the Army to realize this approach will be largely dependant on its community to adopt this new philosophy. Effort will need to be dedicated to managing this culture change. Implementing an enterprise PDM system is a significant effort. Changing the base philosophy of operation and management will increase the stress, training, implementation effort, and resistance to change.

The Web based access is described as both consumer and reviewer based (search, retrieval, approval, markup, redline, etc.). No mention of a full functional client is made. We suggest that Web clients could be very beneficial for leveraging existing infrastructures, allowing accesses remotely, managing product structures across systems, etc. Fully functional Web clients are to be released by all the major PDM vendors in 1998, if not already supported today.

The definition for an open architecture and APIs do not ensure that several unique implementations of ACMS can communicate meta-data completely. The COTS solution selected will need to support the concept of transferring meta-data (subset to be same or mapped to standard form) among unique implementations. Making the unique implementations of different COTS will increase this complexity substantially.

ACMS Functional Capabilities vs. COTS PDM Solutions

The following comments are separated into the categories defined in the CIMdata PDM model that has been used by CIMdata and industry to compare and contrast PDM COTS solutions.

Data Vault and Document Management

The data vault and document management capabilities are the core of most COTS PDM solutions. The vault is used to store and manage all types of product information. Given the number of users that will ultimately need access to the data and the quantities of data to be controlled, it is important the managed data is stored in a distributed, heterogeneous computing environment.

Most COTS PDM solutions provide access controls that have the ability to establish permissions at the attribute level in addition to objects themselves. Many of the solutions provide mechanisms to segment, for security reasons, meta-data and managed data by specific attributes such as customer or owner.

The data vault and document management requirements described in the ACMS CONOPS vision document are generally supported by the major COTS PDM solutions, including the concept of federated data vaulting. The major area of concern is the lack of discussion related to the use of versioning and revisioning of object management by the PDM system.

The concept of revision vs. version is interchangeable depending on specific customer requirements. The capability is essentially to manage a two level release scheme, i.e., Part is at revision B when released, as the part is revised, revision B goes through many intermediate versions (1, 2, 3, 4, etc.) until it is approved and a new revision C is finally released into production. Of course, this is from a typical engineering perspective. In many discrete manufacturing organizations, there are no revisions or versions for parts in production (Form, Function or Fit changes cause a new part number to be created). It is not clear what exactly the US Army's requirement is and what is the current practices in the supply chain. Moving from a document centric data management philosophy to a product centric philosophy will require attention to this issue. We recommend that a two level scheme be adopted, even if users do not immediately use it, ACMS will use it internally to deliver other requirements defined in this ACMS CONOPS vision document.

Workflow and Process Management

Using Data Vault and Document Management alone, a PDM system can react to users' ad hoc demands. With Workflow and Process Management, a PDM system can, in addition, be proactive. It can interact with people, working according to pre-defined business processes of an organization and with data and documents, to achieve corporate objectives. Repetitive processes can be programmed within the PDM system and it can map a model of the organization. Workflow and Process Management provide a route to drive a business with information.

Generally speaking, the Workflow and Process Management function found in many of the major COTS PDM solutions work in conjunction with Data Vault and Document Management to provide tools to define and implement various processes and workflows. These processes and workflows, such as engineering change, design review and approval, manufacturing planning, etc., are based on the enterprise's business rules.

The ACMS CONOPS vision document details a number of requirements related to desired workflow and process management functionality. Generally, these desired capabilities are supported by the major PDM COTS solutions. While there exists a number of PDM systems that will support the vision, the extent of workflow and process management support does vary. The main area in which most PDM systems vary is the extent to which they provide tools to create and modify workflows in a graphical environment. It is unclear if the ACMS CONOPS vision details the type of workflow environment to be delivered to the system administrators and the end users. Other areas of concern or lack of clarity include:

• Should system administrators and/or the end users, given the proper authorization, be allowed to alter workflows once they have begun?

• It appears that there is a desire to have the workflow monitor and balance workload across resources. This functionality is not generally provided by COTS PDM solutions. A considerable amount of customization may be required to provide this functionality.

• There is some discussion on the desire to allow users to check work queues for workflow tasks assigned to them. This functionality is generally provided through the PDM's "in basket" or email messaging functionality in many COTS PDM solutions.

• The ACMS CONOPS vision document does not provide enough information related to the extent to which workflow modules between PDM systems within the federation and outside the federation will be or will not be integrated. A tight integration between PDM systems provided by different vendors will be difficult at best. In fact a tight integration may be impossible to accomplish at any reasonable cost. The extent and the purpose of such integration must be defined as soon as possible in order to determine its impact on the requirements.

• The ACMS CONOPS vision document also does not provide enough information related to the desired workflow integration with JCALS Workflow Management Systems. The Workflow Coalition Group is working on a standard for different workflow systems to transfer workflows; however, it is not yet widely available or implemented. As we do not know much of the capabilities of the JCALS system nor its interface capabilities, it is not possible for us to comment further other than to say we are greatly concerned with what COTS PDM vendors can provide in this area today.

• The statement "…ACMS will improve efficiency … by dynamically adjusting access as user roles change with receipt of specific tasks." (3.2.5) Appears to be backwards. Generally, users defined in a COTS PDM solution have multiple roles or user groups that in turn define the access rights for that user. Objects are typically controlled by their status levels, which in turn define what actions can be applied. Users are given rights through lists of actions for objects through their user id, user group or role.

Product Structure and Configuration Management

Major COTS PDM solutions provide Product Structure and Configuration Management facilitates that manage the creation and continuous management of product configurations

and Bills of Material (BOM). As configurations change over time, PDM systems track versions, effectivities, and design variations. Typical product structures contain attribute, instance, and location information in addition to standard BOM data. This data enhance the structure's value for activities outside of manufacturing planning. Standard BOMs can be generated automatically from the product structure.

As parts change throughout the design process they can be controlled by a PDM system. Major COTS PDM solutions allow different views of the Product Structure to be used by different parts of the organization (costing, engineering, production, purchasing, etc.). Generally, PDM systems are expected to allow variations (views) of the product's structure to be created and maintained in a controlled, inter-related manner.

In general, the product structure and configuration management capabilities that are described by the ACMS CONOPS vision are supported by the major PDM COTS solutions. The main areas in which most PDM systems vary is the extent to which they provide tools to create and modify complex configurations and their ability to create and manage configurations in a graphical environment. These are areas that need further clarification and analysis. Additional areas of concern or lack of clarity include:

- It is unclear if the ACMS CONOPS vision details how complex a configuration environment is required and if the configuration environment exists across the federated environment, thereby requiring capabilities such as BOM comparisons across systems.

- It is also unclear what is meant by "automated … configuration management of data?" This statement (2.2.4.5) requires more detail in order for a determination to be made on if this functionality can be provided by COTS PDM solutions.

- The ACMS CONOPS vision document does not appear to discuss the need and/or desire to integrate the movement of BOM information back and forth between CAD/CAM systems or other types of existing systems within the Army's systems environment.

Classification and Retrieval

Classification and Retrieval is the association of attributes to product data so those similar items can be related in a way that they can be found and referenced. Part classification is also referred to as Group Technology. The Classification and Retrieval function is used to search for documents, data, parts, standard components, processes, and objects. Examples of data fields that can be used as search criteria include part function code, data type, project, status, release date, and designer. The user may specify ranges and logical combinations of these and other user-definable fields for searches. In some systems, classification schemes are maintained in the form of hierarchical structures. For these, the classification structure can be queried to find parts matching appropriate criteria.

Most PDM classification functions provide more efficient mechanisms for finding standard and similar parts than do catalogs and other manual systems. When engineers and designers are able to find standard and similar parts easily they are more likely to re-use them instead of designing from scratch. There will be less "re-invention of the wheel."

The classification and retrieval requirements described in the ACMS CONOPS vision document are generally supported by the major COTS PDM solutions. The major area of concern is the desire to retrieval information owned and managed by other systems, such as JEDMICS installations. This type of integration will require robust APIs and some type of common data schema, such as MIL-STD-2549. This type of integration capabilities can be found, however, the effort in both time and money will be significant.

There appears to be a desire to have command line query capability. This mechanism is usually considered to be inferior to on-line graphic query interfaces such as the type provided by tools such as MS Access. The ACMS CONOPS vision document is not clear why this capability is desired. This requirement should be studied further.

Program Management

There is a growing interest in program management facilities integrated with PDM. A system offering both PDM and program management will increase the scale of application of the PDM program (size of installation and number of users). The point of interface is likely to be through design release management via managed parts structures with associated data objects, and their associated states.

The basic capability that is generally required from the Program Management function is to create and modify a Work Breakdown Structure (WBS). The WBS is typically a structure of major tasks, sub-tasks, and detailed tasks. Resources and expenditures may be assigned to each WBS task. More extensive Program Management functionality includes relating WBSs in a PERT/CPM or GANNT chart-like fashion, determining critical path items, resource scheduling, and load leveling. Expenditures may be monitored for each task and compared with the budget.

This functionality is currently very poorly supported by COTS PDM solutions. Because of this fact, the ACMS CONOPS vision described will be difficult to implement without a major customization effort and integration to a project management application.

Communications

A PDM's on-line capabilities related to the automated notification of critical events means that all personnel are informed concerning the current state of the project. Designers and others know as quickly as possible when product information is ready to be processed through the next task and which information is the most up-to-date.

A software mechanism known as a "trigger" is usually used to spawn notifications and other actions automatically. Almost any event in the product development process can cause a message to be sent or cause another event (such as the translation of data to another format) to occur. Triggers are used to streamline data vault and document management and workflow and process management procedures.

The major COTS PDM solutions support the functionality desired as described by the ACMS CONOPS vision document. The one area of concern is the desire to have the ACMS federation send and receive communication from other systems. This capability is

heavily dependent on the others systems' capabilities to operate in such a manner. This may or may not exist.

Data Transport and Translation

Moving or transporting data from one location to another or from one application to another is an operation that many COTS PDM solutions are designed to perform. Generally, the users don't need to be concerned with operating system and network commands.

Typically, the system administrator can pre-define data translators to be used to convert data between pairs of applications and to formats for various display and output devices. This allows enforcement of standard data forms. While translators may not be provided as an integral part of the PDM system, they may be applied because the system knows the data format of each controlled file and which translation is appropriate.

There does not appear to be any desired functionality related to data translation that the major COTS PDM solutions can not handle, either by themselves or with a standard integration with third-party tools.

Most of the desired data transport capabilities can be provided by the major COTS PDM solutions available today. However, the stated desire to have the ACMS federation "… formulate a request for data [data not controlled by the federation], submit the request to the controlling system, receive the requested data or response notice …" will be difficult to implement. Generally speaking, data not controlled by the PDM can not be accessed by the PDM. The PDM may have meta-data on the foreign object but that is about it. This will require the duplication of data between systems and possibly a complex synchronization scheme.

Image Services

Major COTS PDM solutions provide Image Services (IS) functions for working with both raster and vector graphical image data. These PDM systems typically provide a basic service for the "viewing" or reviewing of graphical images of both computerized and hard copy documents (such as specifications and engineering drawings, CAD designs and models, manufacturing information, and other PDM-controlled data sets and documents). View capability allow electronic access to product information for a wide range of potential. Many PDM systems provide image services by integrating an image application supplied by another vendor. A growing trend in the PDM market is the integration of 3-D assembly modeling tools that can import 3-D models from different CAD systems and allow users to view, inspect, and redline these assemblies. We suggest that this additional capability be added to the requirements for ACMS.

Many of these integrated third-party systems provide view and mark-up capabilities including multi-layer mark-up, mark-up layer integration from multiple reviewers, access and security rules for layer access and modification, linking mark-ups to objects, and

maintenance of mark-up to document and item relationships in engineering change processes and configuration management activities.

The integration with one or more image tools that provide the users of ACMS with the functionality desired should not be an issue. However, it should be noted that these tools generally do not support the creation of viewable images beyond those created when marking up an existing created image.

Administration

System administration capabilities play a key role in the implementation of any COTS PDM solution. The administrator is responsible for the overall implementation and customization of the PDM system. Major PDM systems provide computer system management functions, such as:

- Define and maintain meta-data
- Manage user authorizations
- Manage data distribution
- Manage archives and backups
- Manage rollback/recovery after system problems or failure
- Client management, the ability to automatically distribute new client releases of the PDM system

Object data fields include any meta-data associated with a PDM controlled entity. Examples include author identification, supplier ID code, and release level. These meta-data comprise the core of management information generated by the PDM system. Generation of meta-data behind the scenes by the administration software ought to be done with minimal disruption to users' normal work patterns.

The administration capabilities described in the ACMS CONOPS vision document are consistent with the functionality provided by many of the major COTS PDM solutions. Extra attention should be paid to the PDM system's security capabilities. The extent and ease to which a particular PDM system can support a complex security schema varies widely by COTS PDM solution. Some have extensive capabilities that manage security down to the field level while others don't.

Of course, the US Army is required to work within government (NSA) rules for the management of classified and unclassified data. It is unclear how the ACMS vision of permitting access to ALL product data and configuration data to those with correct security access rights, if the data is not accessible from a single environment (ACMS). It is perhaps possible, that different ACMS systems are deployed (one for classified data, the other not) and they function in the Federation of Systems transparent to the end user. But will this require both types of ACMS at each Army Command? The ACMS CONOPS vision document is not clear enough on the impact that security will require from the COTS vendor.

User Interface

It is typically found that some employees have hands-on experience with UNIX environments, and most have experience with Windows environments. Because of this a Windows-style or Web browser user interface is essential. Strictly menu-driven or command-line systems are generally not acceptable by the typical user. The quality of the user interface is an important element in the selection of a COTS PDM solution.

The desired functionality described in the ACMS CONOPS vision document, the major COTS PDM solutions should be able to support them. It should be noted that many of the major PDM systems have other capabilities, such as user defined help that can greatly enhance the user's ability to operate within the PDM environment.

Application and Legacy Systems Interfaces

The ability of a COTS PDM solution to integrate with another system is greatly dependent upon both systems' APIs, the architecture of the systems, and most importantly the method of interface development and deployment. The integration requirements defined by the ACMS CONOPS vision document is very extensive. It should be noted that it is possible that the integrations desired will cost much more than the COTS PDM software itself.

Operating Environment

Most COTS PDM solutions designed to operate within a heterogeneous computing environment. Most server-based software operate on UNIX and/or NT and most client-based software operate on UNIX and Windows. A few PDM systems can provide a Macintosh client. It is unclear what the ACMS CONOPS vision is for operating environment. Since most major PDM systems operate on a wide range of operating systems it is felt, at this time, that there should no issues regarding the ability to support the desired operating environment if it is close to the current market expectations.

Distributed Environment

As mentioned before the support of distributed or federated environments are not currently widely supported beyond data vaulting and limited process management. Because of this it is extremely important for the vision of ACMS to be further developed to include the phased timing for the support of such a federate environment.

Customization Environment

The extent and ease to which a COTS PDM solution can be customized generally is determined by its,

- Application Programming Interface – that usually allow the user to access and store PDM-managed data from within the originating application environment.

- Architecture of the System – this will define the limits and possible customization (data modeling, data dictionaries form generation tools, report writers, development environment access, Graphical User Interface tools, etc.)

- Triggering System Activities – these are used to trigger custom routines and applications, thus automating specific activities.

- Customizing Attributes – In addition to supporting a list of standard meta-data attributes, the major COTS PDM solutions support custom attribute definition.

- Rules-Based Attribute Selection – usually provide the ability to select a set of attributes for data entry based on the user's identification and project membership is an important feature.

The extent and ease is also dependent on the direct customization support the PDM vendor can and is willing to provide.

It is extremely important for the ACMS CONOPS vision that the COTS PDM solution or solutions selected support robust capabilities in the area of tailoring, customization and support.

Summary

In summary, we feel that this ACMS CONOPS vision document is generally consistent with the requirements of large discrete multinational enterprises. The major PDM vendors are actively addressing this market and so many of the capabilities defined in the ACMS CONOPS vision document are available in COTS solutions.

The requirements we have identified in this review document that are concerns may fall outside the current COTS solutions and will require custom development either prior or concurrent to deployment.

We further recommend that component technologies be investigated such as 3-D assembly viewing and markup and Web based infrastructure applications for access to legacy and PDM systems. Other technologies can be discussed with BDM at a later date.

The ACMS CONOPS vision document is, in our opinion, more like a Request for Proposal (RFP). This is not in itself bad, but it is much more detailed than the typical vision document created by the commercial market. The US Army could easily convert this work into a RFP. To illustrate this, CIMdata has also delivered to BDM, per their request, a copy of the CIMdata PDM RFP template electronically.

We feel that this ACMS CONOPS vision clearly defines a long-term strategy for the US Army that is more in line with the commercial market. The challenge will be to accommodate all the specific security, interfacing and distributed capabilities required by the Army.